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4. Introduction

The objective of this research is to exploit the findings of Project Vanguard Phase I and II to produce more robust scientific tools for graded alerting of transnational biological threats using Venezuelan Equine Encephalitis (VEE), a mosquito borne viral disease, as a case study. These new tools will play an essential role in future research and contribute to advancing TATRC's mission in the use of Indications and Warnings (I&Ws) biosurveillance for biodefense.

Indications and Warnings (I&Ws) potentially alert U.S. responders of an imminent foreign bioevent weeks to months in advance. I&Ws are markers occurring globally, outside of U.S. borders, before an outbreak can affect U.S. interests, forces or domestic territory, thus allowing the U.S. time to respond. In effect, I&Ws can prime the national response infrastructure by alerting agencies of an evolving threat that could ultimately be highly disruptive or catastrophic.

Venezuelan equine encephalitis (VEE) virus is a zoonotic, mosquito-borne, viral disease affecting humans and equines where equines serve as amplifying hosts. It is an RNA alphavirus of the Togaviridae genus that is serologically classified into six antigenic subtypes: I-VI and six varieties: A, AB, C, D, E, F (1). Epizootic/epidemic type IAB and IC are the only subtypes associated with significant human and equine outbreaks (1,2).

VEE has caused periodic outbreaks in humans and equines in Latin American since the early 1920s. Considering that epizootic VEE has not been diagnosed or isolated in the United States since 1971, there are concerns that VEE would make an effective bioterrorist agent (1,3,4).

VEE is considered an incapacitating agent rather than a lethal agent such as anthrax or plague. Past outbreaks have suggested that a low infective dose is necessary for transmission (4,5). Its primary incapacitating consequence is compromise of the civilian healthcare delivery system and paralysis of the military, whose resources would be stretched caring for sick soldiers (3). Furthermore, VEE is relative easy to produce and distribute by intentional aerosol or release of infected mosquitoes, and has a history of being researched as a bioweapon (4). All these factors make VEE a potential bioweapon that warrants examination.

5. Report Body

This section describes the research accomplishments associated research performed from 1 June 2004 to 31 December 2004. The award number is DAMD17-94-V-4015.

5.1 Task 1: Analysis of the anatomy of a bioevent concept

Demonstration of the broader applicability of the anatomy of a bioevent concept is needed - especially for pathogens of homeland security importance such as VEE. From this conceptual perspective, the Vanguard team completed a full reanalysis of one of largest recorded VEE outbreaks, which occurred in Venezuela and Colombia from April through December of 1995 (1), to define the sequential appearance of I&Ws. The epidemic involved an estimated 75,000 – 100,000 human cases with more than 300 associated human deaths (5,6). Actual numbers are ambiguous due to poor reporting from indigenous groups located in the Guajira peninsula shared by Venezuela and Colombia (2,3). Although associated equine deaths were estimated to be significant, reliable estimates of affected horses were unavailable and the literature cites a relative small number of equine cases compared with the profusion of human cases (5). This paper focuses on the Venezuelan portion of the epidemic.

The epidemic began in Falcón state, located along the northern coastline of Venezuela, in April 1995. By the end of July, cases had been detected south and west of Falcón in the states of Lara, Carabobo, Yaracuy, and Zulia. By August, the epidemic quickly spread to the Guajira peninsula in the far west of Venezuela on the border with Colombia. Cases continued to appear in the southern and western Venezuelan states of Trujillo, Portuguesa, Cojedes and Guarico through the end of 1995 (5). The state of Zulia was impacted most, with approximately 10,000 human cases (7). At the time of the outbreak, emergency control measures, including restriction of equine movement, equine vaccinations, and insecticide fumigations, were enacted to stop the spread (1,8-10).



Figure 1: Map of Venezuela and Colombia showing regions affected by the 1995 VEE outbreak (5)

Although the viral source of the epidemic has yet to be proven, several theories have been discussed that could explain the periodic emergence of VEE: (i) evolution of epizootic strains from enzootic subtype ID progenitors; (ii) circulation of epizootic viruses as subpopulations within enzootic strains; (iii) continuous circulation of epizootic viruses in cryptic cycles; (iv) reemergence of epizootic strains from latent infections; and, (v) reemergence of epizootic strains from incompletely inactivated vaccines (2). Additionally, there has been some speculation that the 1995 outbreak was caused by a laboratory strain (2).

Several key conditions in Venezuela contributed to the epidemic, including diminished equine vaccination coverage, lack of surveillance, limited knowledge of equine encephalides, and increased viral activity following smaller VEE outbreaks in the same Trujillo and Zulia states in 1993 (7,11,12). Unusually heavy rainfall was noted both in Venezuela and Colombia, which appeared to favor an over-proliferation of *Aedes taeniorhynchus*, *Psorophora confinnis*, and *Anopheles aquasalis* vector mosquitoes. This rainfall was noted to be the highest in 18 years, and coincided with the apparent 15 to 20 year periodicity of major VEE outbreaks in Venezuela and Colombia. Precipitation was considered a major factor in favoring VEE outbreak initiation and propagation via enhancement of vector breeding sites (5,6,8-10,13).

Local and regional media in Venezuela began reporting the outbreak during the months of June, July, and August. The national Venezuelan press had sporadic reports beginning in late July, although coverage was fairly light until September. Reports among the international community appeared on September 5 when an Agence France Presse report described a

mysterious epidemic sweeping through a rural area in Venezuela (14). On September 7, Promed, a global electronic reporting system for outbreaks of emerging infectious diseases and toxins, posted the first mention of an encephalitis epidemic in Venezuela (15). This was followed by miscellaneous new reports in the international press until the Pan-American Health Organization (PAHO), a regional office of the World Health Organization (WHO), released an official news report on September 21 (16,17).

5.2 Task 2: Indications and Warnings for inclusion in the Argus Initiative

Monitoring I&Ws that indicate a bioevent of significant societal disturbance potential is present requires retrospective evaluation of past epidemics. The Vanguard team evaluated the 1995 epidemic of VEE in terms of cataloging I&Ws that could signal the presence of VEE as a bioevent of societal disruption potential. This includes markers for enviro-climatic triggering, veterinary and livestock disease markers, and stock market and gross level telecommunication changes.

The summary I&W Concept Map for VEE event detection is shown in Figure 2. Description of the social disruption model may be found in Appendix A; the social disruption model is still in development per Project Argus.

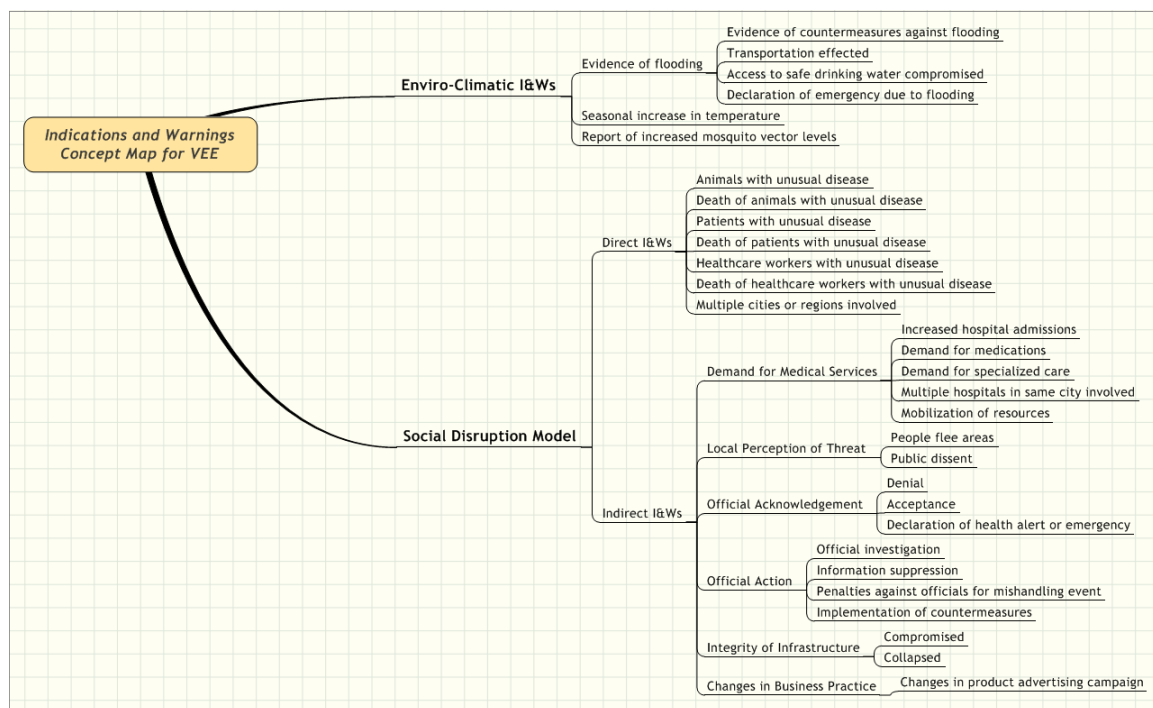


Figure 2. Indications and Warnings Concept Map for VEE

A significant enviro-climatic trigger event was recorded by remotely sensed instrumentation. Much to the surprise of the Vanguard team, multiple I&Ws of a full social crisis were present in local and regional media sources two months in advance of the first Promed or WHO report of the epidemic. Of tremendous significance, the I&Ws for social disruption observed for VEE correspond to the same social disruption I&Ws observed by the team for SARS in China, plague in Turkmenistan, Spanish flu of 1918 in USA, and FMD in the UK (2001). Thus, we observed the possible broad application of the “anatomy of a bioevent” concept.

5.3 Task 3: Open Media, Internet, and Literary Sources

We discovered that open news media and online Internet newspapers in Venezuela during 1995 are unavailable electronically. 2001 was the earliest date of electronically archived information. As a result, we explored the Venezuelan sources in the newspaper archives at the National Library of Venezuela in Caracas and the Library of Congress in Washington.

Local and Regional Sources

We traveled to Caracas and obtained information from five distinct newspapers from locations where the disease was first reported (1). We reviewed articles and advertisement sections to determine relevant I&Ws for the 1995 epidemic. The five newspapers we examined were: *El Falconiano*, a local paper from the city of Santa Ana de Coro, Falcón state; *El Carabobeño*, a regional paper from the city of Valencia, Carabobo state; *Yaracuy al Día*, a local paper from the city of San Felipe, Yaracuy state; *El Impulso*, a local paper from the city of Barquisimeto, Lara state; and *Panorama*, a regional paper from the city of Maracaibo, Zulia state. These five newspapers represented a mixture of locally and regionally circulated press and were deemed by investigators to be a representative sample of media coverage during the 1995 epidemic. Although the National Library held many newspapers from geographically diverse regions in Venezuela, research time constraints limited the scope to one newspaper from each of the states initially affected by VEE. Bilingual team members evaluated each article for relevant I&W categories and parameters.

National Sources

We obtained information from the two national Venezuelan newspapers held by the Library of Congress, *El Nacional* and *El Universal*, both from the city of Caracas in the Distrito Federal. We chose the two papers because they were the only available sources held at the Library of Congress for 1995 and because the team had not focused fully on the reporting of environmental conditions in the local and regional media during the trip to the National Library in Venezuela due to time limitations. We reviewed articles and advertisements to determine environmental conditions in 1995 that may have created favorable conditions for a VEE outbreak.

5.3.1 Indications and Warnings of Social Disruption: Local and Regional Newspapers

Although supplementary articles were available in addition to those cited in this article, in order to maintain the focus and clarity in reporting, the investigators decided to provide one to three examples for each parameter noted on our I&W matrix (attachment A). Many cited articles contain additional I&Ws to those referenced in this paper.

April 1995

Unusual Disease Reported: A single news media report in *El Falconiano*, Falcón state, on April 27 notes the evaluation of the health of horses and thus offered one I&W parameter: *implement countermeasures* (18). Although the article failed to mention VEE specifically, it is significant because it suggested that the community was gearing up against its appearance.

May 1995

No reports are available for May.

June 1995

A single news media report in *Yaracuy al Día*, Yaracuy state, on June 22 provided one direct and three indirect I&Ws.

Unusual Significant Disease Reported: The June 22 report in Yaracuy noted cases in the neighboring state of Falcón. This report demonstrates *unusual significant disease in animals* as a media report covering an outbreak of a potentially highly transmissible or catastrophic disease which is not routinely carried by local press (19).

Official Acknowledgement and Official Action: The June 22 article describes official agreements on control measures, such as a sanitary cordon and health alerts, enacted by the Servicio Autónomo de Sanidad Agropecuaria (SASA), the governmental group which responds on a national level for animal and plant health on behalf of the Ministry of Agriculture (MAC). Additionally, the article explained that samples were being sent to laboratories for viral classification. This article represents *official acceptance*, *implement countermeasures*, and *official investigation* (19).

July 1995

The abundance of news reports in July suggests that the outbreak intensified. Investigators collected over 80 articles that contained multiple I&Ws of the epidemic. At least one representative example is provided here.

Unusual Disease Reported: Numerous articles in July referred to an epidemic involving horses and humans. These reports represent *unusual significant disease in humans*, *unusual significant disease in animals*, and *animal deaths from unusual significant disease* (20-22). Many articles mention disease in several cities and states, and thus represent *multiple city involvement* and *multiple region involvement* (20,23,24). Furthermore, a human death report corresponds to *deaths of patients from unusual significant disease* (25).

Demand for Medical Services: Reports suggesting a demand for medical services appear throughout July. Articles that mention that agricultural producers and cattle associations were concerned about the lack of vaccines to immunize Miranda state's equine population account for *demand for medications* (26-27). References to the transfer of an infected patient from Yaracuy state to Lara state represent *demand for specialized care* (28). The *mobilization of resources* is cited after the regional government appropriates funds for vaccines and promises free vaccinations to small farmers (28-29).

Local Perception of Threat: *Public dissent* began to appear in July. The media covered criticism from local veterinarians and cattle associations. These organizations complained that the government failed to deliver assistance and enforce official countermeasures, such as restriction of equine movement (30-32).

Official Acknowledgment: *Official acceptance* also surfaced in July, including reports regarding announcements of a state of health emergency and vigilance, establishment of countermeasures, and open access of animal and human case figures to the public (21,25,33-34).

Official Action: During July, many articles demonstrated *official investigation*, as the reported laboratory testing of blood samples and utilization of investigatory assistance from organization such as the Pan-American Health Organization (PAHO), a regional office of the World Health Organization (WHO) (35-37). Although local PAHO offices were involved in the epidemic, official new releases were not internationally available until September (17). *Implement countermeasures* included pieces on public health announcements, conferences on the epidemic, and official prevention measures including equine movement restrictions, vaccination programs, and fumigation for mosquito control (20,21,38-40).

Integrity of Infrastructure: Reports on the cancellation of normal activities that involved equines, such as bull fights and agricultural fairs, were noted in July and accounts for *compromised infrastructure* (21,40,41).

Changes in Business Practices: A single advertisement that appeared on July 21 in El Carabobeño added an additional category to the I&W matrix: *changes in business practices*. Conveniently, an advertisement for a pharmaceutical company was found right underneath an article describing the plight of veterinarians in fighting equine encephalitis. The advertisement congratulated veterinarians for their daily community efforts, strongly suggesting the awareness that local pharmaceutical companies had of the veterinary outbreak and the veterinarians' role in controlling it (42).

August 1995

Despite news reports suggesting that the epidemic remained in full swing, the number of articles retrieved from the five newspapers slowed down significantly in August. Out of 30 plus articles that reference I&Ws of the epidemic, we have provided at least one example here.

Unusual Disease Reported: Continued reports of the epidemic demonstrate *patients with unusual significant disease* and *animals with unusual significant disease* (43-46). Although human deaths were reported in July, no *deaths of patients with unusual significant disease* were noted during August. This discrepancy may result from the government deliberately suppressing information. Animal death counts represent *deaths of animals with unusual significant disease* and the mention of several cities and states with cases represents the involvement of *multiple cities and regions* (43,46,47).

Demand for Medical Services: Reports including *demand for medicine* continued to appear throughout August and included references to the scarcity, lack, or slow production of vaccines (48-50). *Mobilization of resources* is noted in reports that in provincial governments were receiving or soliciting vaccines from other states, cities or countries (48,49,51).

Local Perception of Threat: *Public dissent* appeared throughout August. Several distinct agricultural associations voiced complaints, ranging from threats to refuse signing an animal health agreement, to denying responsibility for the outbreak, to criticizing the Venezuelan National Guard for its failure to enforce equine movement restrictions (45,49,51).

Official Acknowledgment: In spite of human death reports in July, the Minister of Health claimed no human deaths attributed to equine encephalitis, representing *official denial* (44). This is interesting because the Minister of Health, Carlos Walters, was eventually fired for

mismanaging the epidemic, which represented *penalties levied against officials for mishandling events*. *Official acceptance* is present in discussions of human and equine case counts, animal death counts, official countermeasures and health announcements (43,50,52).

Official Action: During August, *official investigations* include reports on veterinary check-ups on equines and sending blood samples to labs for viral confirmation (43,53). Continued mention of vaccination operations, equine movement restrictions, and public health alerts and announcements correspond to *implement countermeasures* (52,54,55)

Integrity of Infrastructure: Reports on equine event cancellations and concentrated restrictions continued throughout August, resulting in a condition of sustained *compromised infrastructure* (46,52,56).

Changes in Business Practices: None are noted in August.

September 1995

The number of articles retrieved from the five newspapers exploded in September. Out of approximately 280 articles that reference I&Ws of the epidemic, we have provided selected examples here.

Unusual Disease Reported: Coverage of patient case counts, increased consultations, and death counts demonstrate *patients with unusual significant disease* (57-59). and *deaths of patients with unusual significant disease* (60,61). Reports of animal illness and death counts represent *unusual significant disease in animals* and *deaths of animals with unusual significant disease* (57,62). Mention of disease in several municipalities and states correspond to *multiple cities* and *multiple regions involvement* (63-66). September marks the first reports of *healthcare workers with disease* (58).

Demand for Medical Services: Media reports on increased hospital consultations and demand for specialized health professionals and patient transfers represent *number of hospital consultations increase* (58,59) and *demand for specialized care* (63,67). Coverage of the continued demand for vaccines indicates *demand for medications* (63,68). Mention of patients in numerous hospitals and increased consultations represents *multiple hospital involvement in same city* and a rise in *number of hospital admissions (consults) for unusual disease* (58,63,69-72). *Mobilization of resources* is present with reports of vaccine importation from Mexico and Colombia (64,68,73).

Local Perception of Threat: September marks intensification of disease as articles mention the escape of indigenous groups from the Guajira peninsula: *people fleeing* (74). *Public dissent* increased with continued reports on dissatisfaction from local agricultural associations and physicians over the ineffectiveness of the regional and national government's prevention, assistance, and enforcement efforts. In addition, suggestions surfaced from physicians and a Maracaibo mayoral candidate that the government was hiding the death toll (66,75,76).

Official Acknowledgment: *Denial* is noted when the Minister of Health downplayed the epidemic's severity claiming that VEE cases had been confused with dengue and influenza. Although he acknowledged 6,200 cases of VEE in humans in Paez, he claimed the situation was

negligible due to the limited deaths caused to date (77). A continued *acceptance* is noted in declarations of health emergencies, case counts, and countermeasures (62,63,67).

Official Action: Outside investigations into the outbreak's magnitude, discussions of studies on actual cases, and investigations into the government's response to the outbreak demonstrate *official investigation* (66,77,78). Rumors of *information suppression* occur when a physician in Paez and a mayoral candidate in Maracaibo insinuated a government cover-up of the epidemic's magnitude by hiding death counts (60,76). *Implementing countermeasures* also appears with reports on states of emergency declared, vaccination and fumigations programs enacted, and equine movement restrictions endorsed (63,73,79,80).

Integrity of Infrastructure: Reports of congested hospitals and overwhelmed doctors represent *compromised infrastructure*. Articles note inundations of febrile patients in Mara, Paez, and Padilla in Zulia; the need to prioritize consultations for children; and a lack of sufficient physicians on duty in Paez to cover the influx of patients (58,81). Coverage of a hospital failing in Moján due to lack of space for patients and lack of medical staff represents *infrastructure collapse*, with the supervisor of the Civil Defense calling to place the hospital in a state of emergency. An additional report notes the failure of a temporary hospital constructed by the Army in the Alta Guajira due to a lack of civilian physicians, another example of *infrastructure collapse* (82,83).

5.3.2 Indications and Warnings of Environmental Conditions: National Newspapers

As a result of the diverse environmental and ecological zones within Venezuela and the lack of Venezuelan regional and local newspapers access in the US, we used the *El Nacional* and *El Universal*, two national newspapers located in the Library of Congress archives, to gauge environmental and ecological conditions from April to September of 1995. As mentioned above, we chose the two papers because they were the only available sources held at the Library of Congress for 1995 and because the team had not focused fully on the reporting of environmental conditions in the local and regional media during the trip to the National Library in Venezuela. There were limitations to this method. In the two national newspapers we reviewed, the northern region around Caracas was covered intensely while the Central, Eastern, Western and Southern regions were covered with less frequency.

April 1995

The first mention of strong rains and floods in the Portuguesa region was noted by *El Universal* on April 3, 1995. The same article noted a prolonged, intense rainy season in the northwest state of Portuguesa from early March through June following more than three months of extreme drought (84). An article on April 15 also noted that drought conditions continued in the north and around Caracas (85).

May 1995

In May, an article noted that countermeasures were implemented against rains, flooding, and general damage (91). On May 24, 1995, *El Universal* noted that drought conditions continued in the north and around Caracas in May (86).

June 1995

On June 4, 1995, *El Universal* reported that Barinas state was experiencing severe flooding (87). Later in the month, on June 20, *El Universal* notes that the first strong rains arrived in Caracas city, causing immediate destruction (87,88). An article also noted that countermeasures were implemented against rains, flooding, and general damage (92).

Throughout the month, there was mention of rising reservoir water levels in central Venezuela, making water difficult to treat and resulting in water rationing (93,94). *El Universal* noted that some extra precautions were taken in northern urban areas, such as rerouting the natural courses of rivers. Transportation was cited as a serious problem numerous times. Many streets were closed or destroyed, and landslides closed down a highway, interrupting cars and public transportation. In June, the situation was deemed a crisis (89,93,97). Articles also called for the public to remain vigilant for instability in buildings, streets and bridges. Sediment from rivers building up was also discussed, with articles noting that structure such as canals were under strain (92,98).

July 1995

The first strong rains arrived to Maracay in Aragua state in July (89).

August 1995

The first strong rains arrived north of Maracaibo in Zulia state in August (90). *El Universal* noted that a state of emergency was declared in Caracas in August due to the rains, resulting landslides, water rationing and lack of water altogether (95,96).

5.4 Task 4: Remotely sensed data

Building upon an earlier VEE pilot study, the Vanguard team furthered the development of the concept of using remotely sensed data to identify areas at risk for VEE (99,100). As noted in the Vanguard Phase III proposal, the 1995 VEE outbreak in Venezuela outbreak was estimated to have spread at a rate of five kilometers per day, ultimately covering a geographic area of approximately 200,000 square kilometers (5,6). The pilot study compared proxy vegetation response patterns, as detected by the remotely sensed Normalized Difference Vegetation Index (NDVI), enabling the Vanguard team to confirm ground observations of unusual climatic conditions associated temporally and spatially with the trigger point and leading edge of the VEE epidemic (Figure 3).

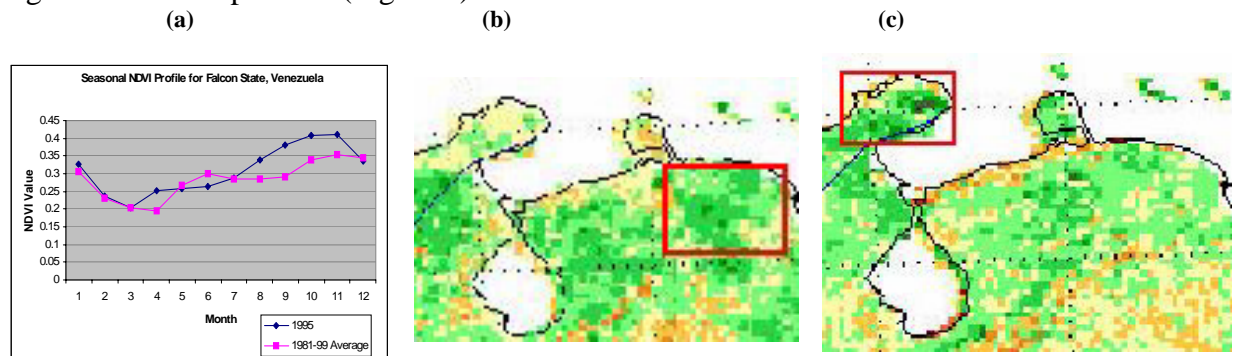


Figure 3. (a) Seasonal NDVI profile for Falcon State, Venezuela, the epicenter of the 1995 VEE epidemic. In 1995, an increased NDVI profile for this site correlated with the first VEE cases seen in horses. (b) An abnormally high NDVI noted for Falcon State, Venezuela in April 1995 (noted with a box), which propagated westward, emerging in La Guarija Peninsula, Colombia by September 1995 (c).

These observations suggested remote sensing could identify both areas at risk for developing VEE prior to appearance of the pathogen, and when an epidemic is underway. The limitations of the pilot study, however, included a lack of sufficient ground meteorological data for a complete analysis and an adequate mathematical model to define enviro-climatic-disease coupling. The meteorological dataset recently released by NASA addressed this critical gap and enabled the full reanalysis of the 1995 VEE epidemic in Vanguard Phase III.

Figure 4 below illustrates the same east to west spread phenomenon observed in the pilot study. This suggests that the environment had been optimized prior to the appearance of disease, thereby establishing “conditions favorable” for epidemic triggering. Evidence of extensive rainfall and flooding on satellite imagery is noted with a rapid reduction of the NDVI profile, indicative of substantial cloud cover related to excessive rainfall. In Falcón, this evidence appears as early as March 1995, with the same phenomenon moving westward to Maracaibo in June 1995 and La Guajira in August 1995. This is notable because VEE first appeared in Falcón in April, in Maracaibo (Zulia state) by the end of July, and La Guajira by late August.

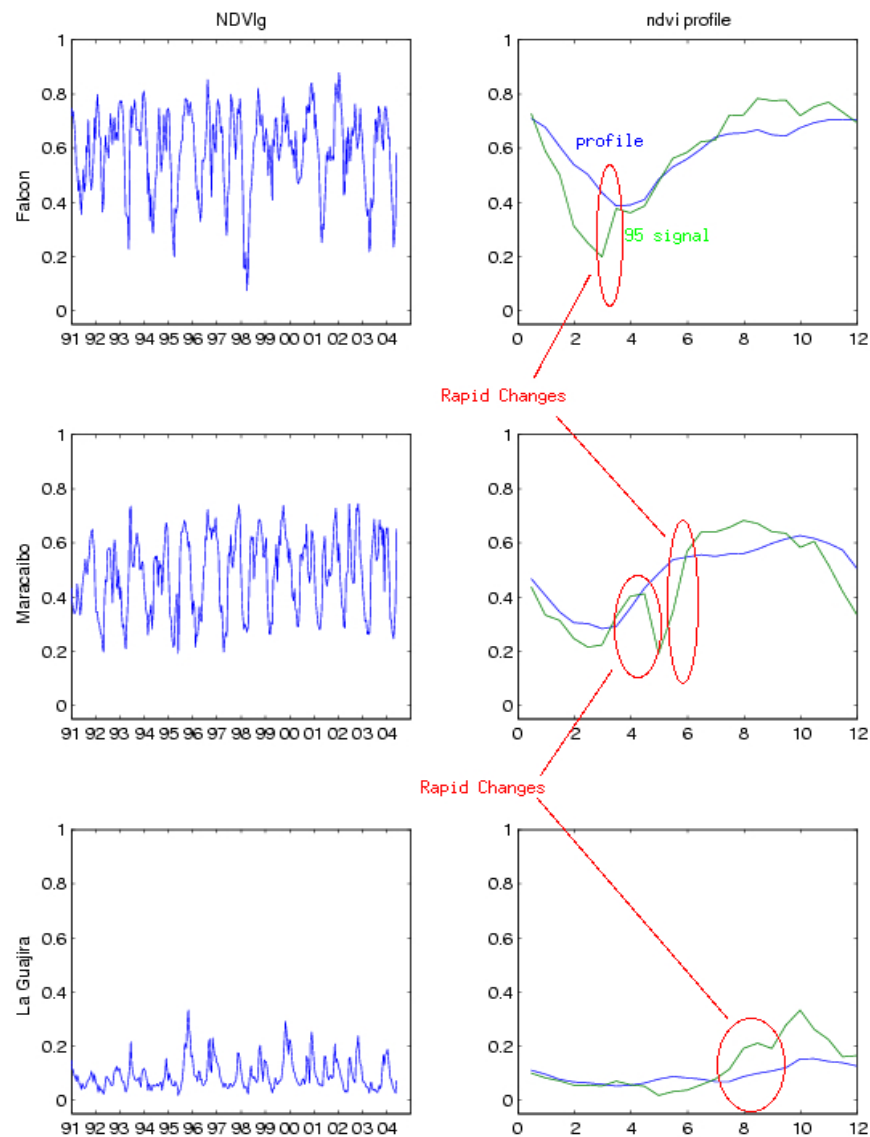


Figure 4: NDVI Venezuela

5.5 Task 5: Transportation indices

Bioevents of catastrophic potential are imported phenomena for the US. The global air transportation grid has been long recognized as a major facilitator of imported bioevents such as HIV/AIDS, WNV, monkeypox, and SARS. Analysis of aggregate de-identified international air transportation data could determine the relevance to U.S. interests of a detected bioevent in a foreign country. Using aggregate, de-identified air transportation data from the Department of Transportation, the Vanguard team assessed when and where the 1995 epidemic of VEE in Venezuela and Colombia would potentially have possibly translocated in the United States by airlight (101).

The total number of inbound passengers from Venezuela to the US has increased since 1993, with both 1993 and 2003 demonstrating a seasonal peak in August as noted by Figure 5. The August peak is of particular concern to the US since the requisite mosquito vectors for VEE are present in the environment at that time and are optimized for transmission due to seasonal temperature peaking seen in July in the US. Figure 6 demonstrates that the same seasonal and yearly air transportation peak was observed in 1995 during the major VEE epidemic in Venezuela.

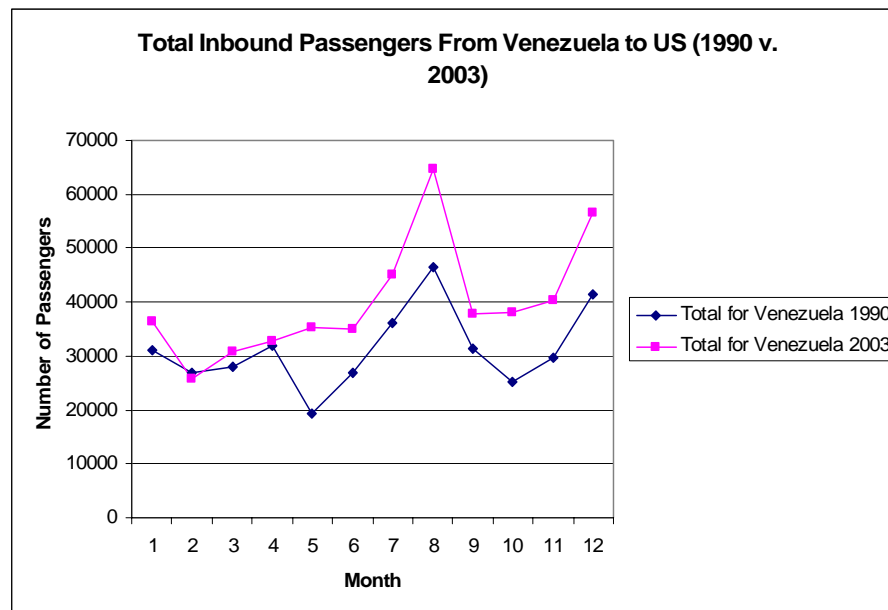


Figure 5: Comparison of Inbound Passengers from Venezuela to US (1990 versus 2003) (101)

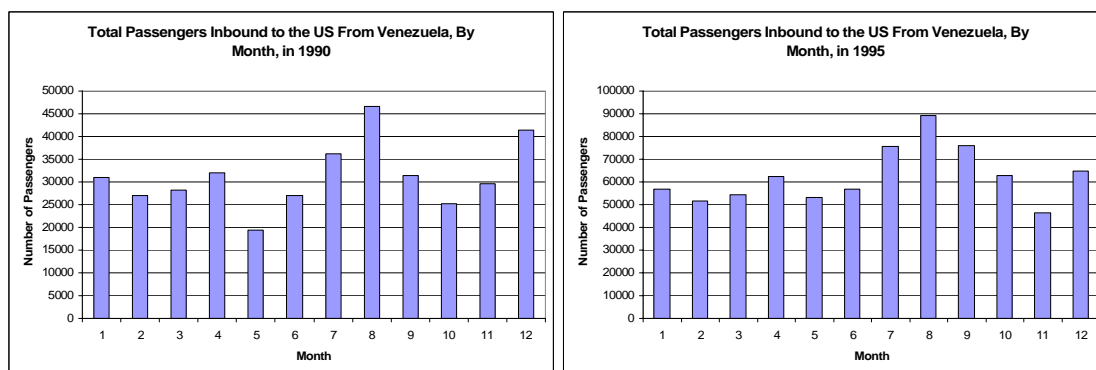


Figure 6: Total Passengers from Venezuela to US, 1990 and 1995 (101)

As noted in Figure 7, Caracas was the main source of traffic to the US in 1995, followed by Maracaibo and Porlamar. Of particular concern, Maracaibo was at the epicenter of the 1995 outbreak and was a potential source of disease translocation to the US. In addition, although the international statistics note Caracas as the main source of traffic, the data fails to account for passengers who travel to Caracas from other areas in Venezuela in order to travel. The top destinations in the US were Miami, New York City and Puerto Rico. Miami and Puerto Rico are of particular concern because local vector mosquitoes live year round and thus provide additional months of translocation potential. New York City is of concern during the summer months, such as August, when transportation indices peak and transmission competency in New York City is optimized.

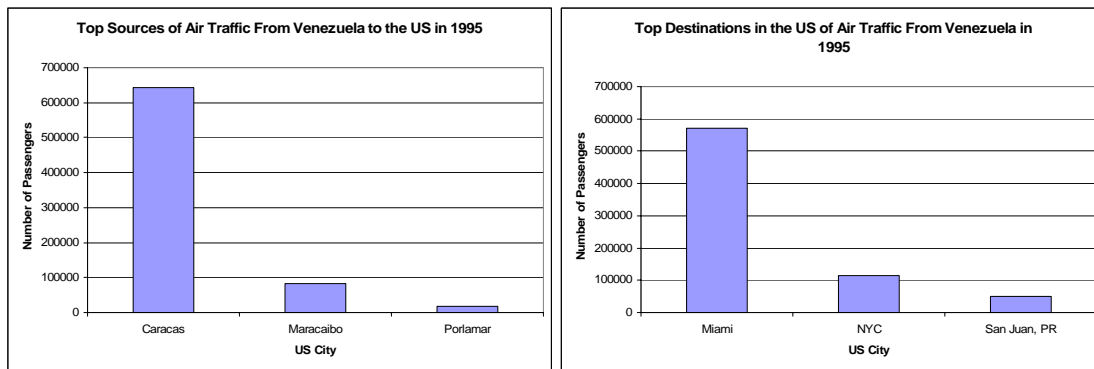


Figure 7: (a) Top Sources of Air Traffic from Venezuela to US in 1990 and (b) Top Destinations of Air Traffic from Venezuela in 1995 (101)

5.6 Conclusion

As shown in Figure 8 and 9, we discovered multiple I&Ws were present in remotely sensed data and local, regional, and national media four months prior to the international public statement issued by WHO in late September 1995. As Figure 10 summarizes, the threat assessment is maximal by August, however we propose alerts to US-local physicians should have been posted by CDC in July 1995, when epidemic containment failure was evident. When comparing Figures 9 and 10, it is evident the US was open to a potentially serious pathogen translocation in July, as was the case with West Nile virus to New York City in 1999. Why VEE did not translocate to the US is better answered by asking, are we *sure* it did not translocate? It is both conceivable and possible the pathogen did translocate, however was unable to trigger a complete transmission cycle that would have enabled an outbreak to progress to an epidemic and subsequent ecological establishment. It is our conclusion that the US was simply fortunate that translocation and subsequent outbreak triggering did not happen.

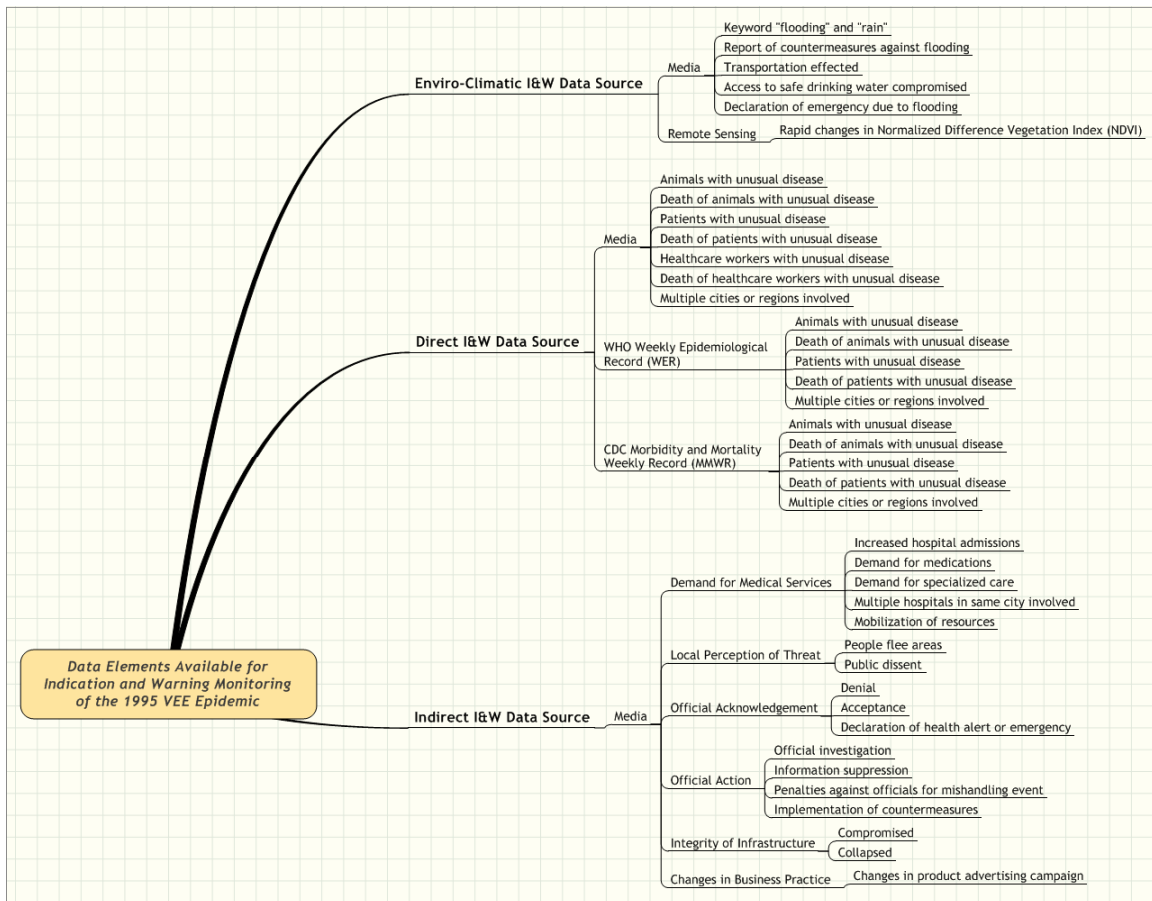


Figure 8. Data elements available for Indication and Warning monitoring of the 1995 VEE epidemic

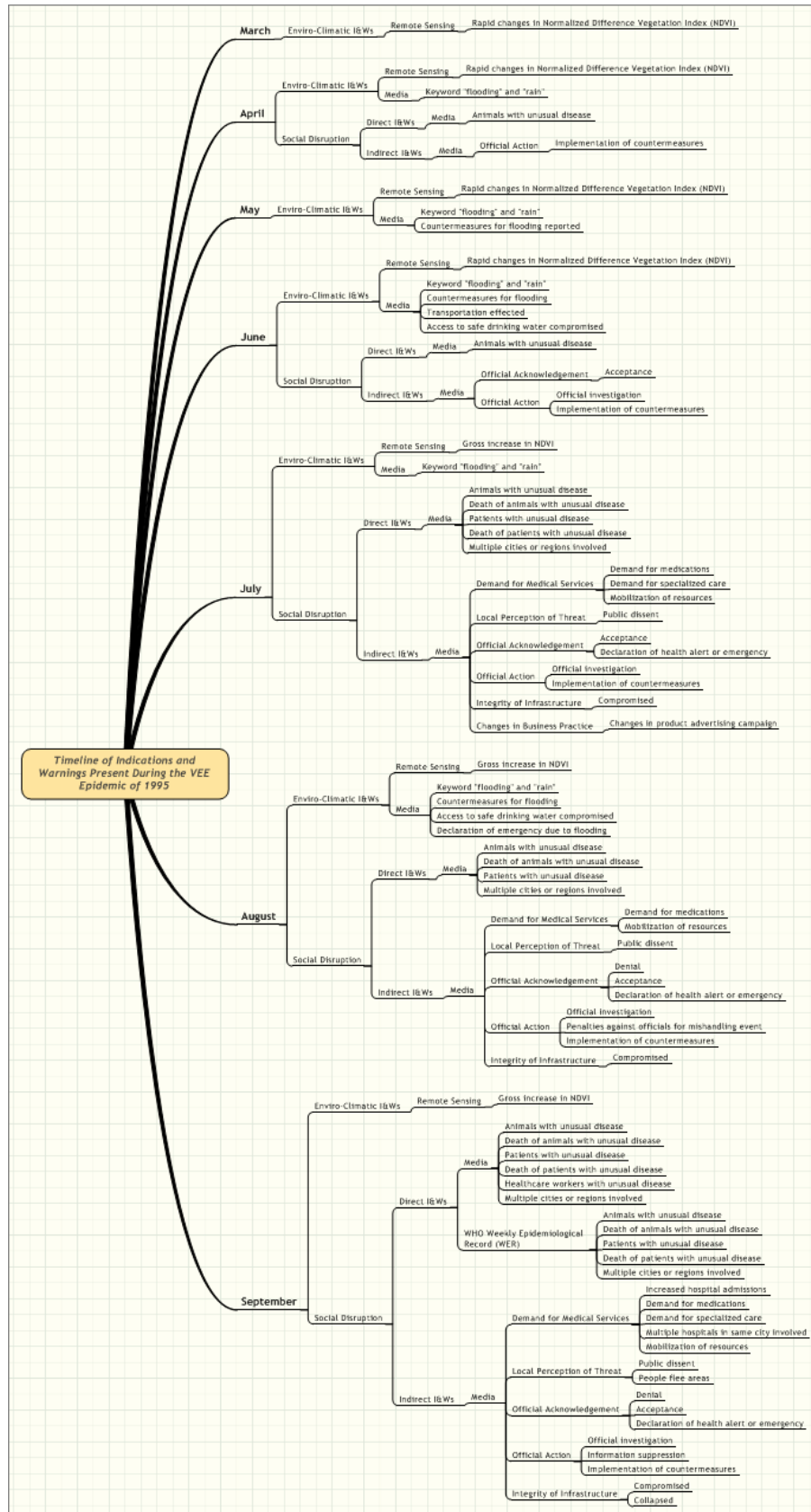


Figure 9. Timeline of Indications and Warnings present during the VEE epidemic of 1995

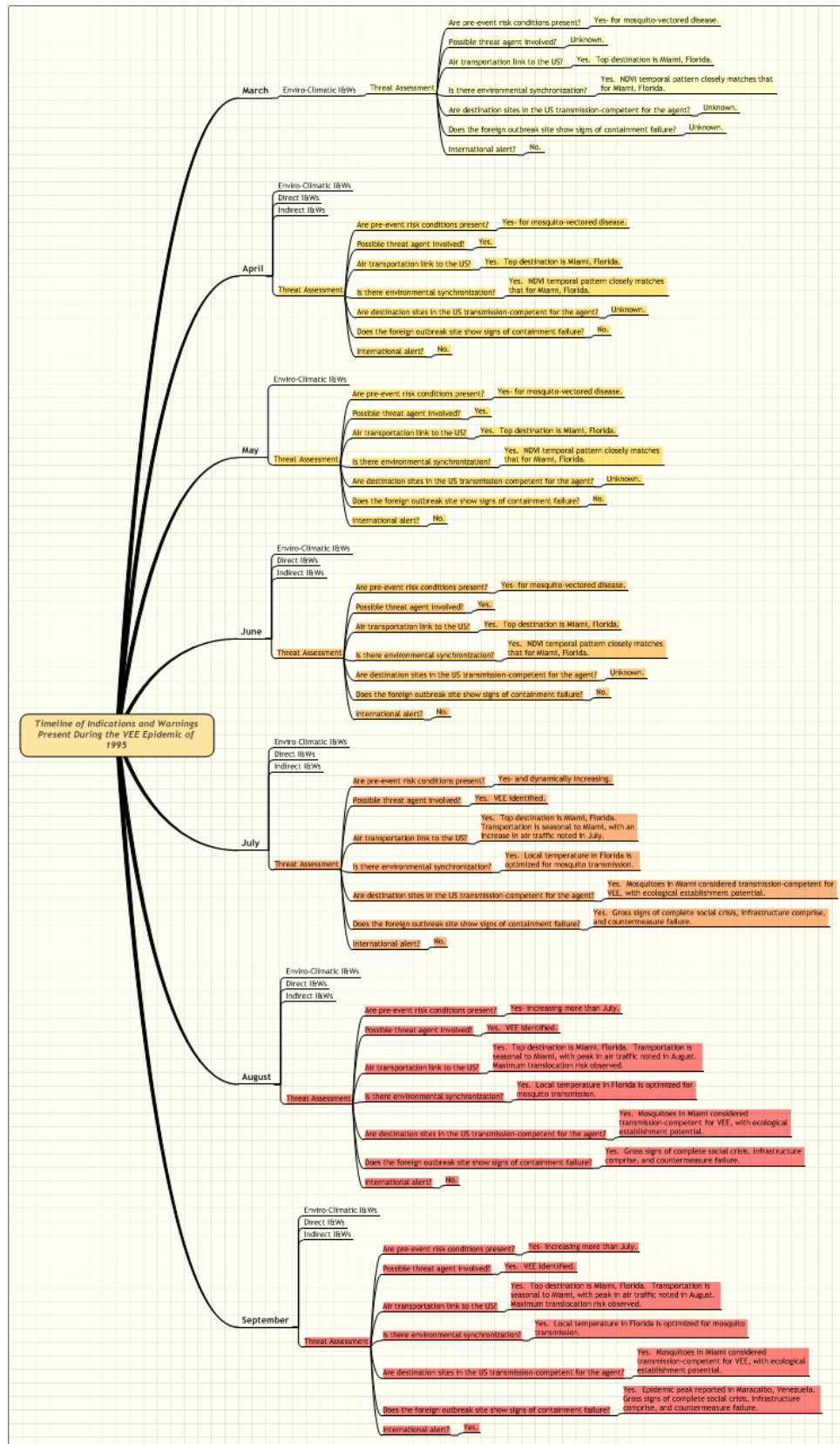


Figure 10. Timeline of Indications and Warnings present during the VEE epidemic of 1995, with threat assessment

The concept map shown in Figure 2 highlights the information needs for a global scanning system for VEE. Based on multiple other case studies we have performed, it is clearly evident there is tremendous broader application to a multitude of other pathogens, both human and agricultural.

6. Future Plans

The VEE case study, along with several other case studies (e.g., SARS, FMD, Spanish flu), have revealed a sheer wealth of research into the “anatomy of a bioevent”. However, this goes well beyond biodefense to include natural disasters, as was evident when considering VEE in 1995. Our laboratory will likely continue investigating this concept for many years to come.

7. Reportable Outcomes: Broad Scale Successes of Project Vanguard To-Date

The overall achievements of Project Vanguard include the following:

1. Development of “graded alerting” for transnational and domestic threat agents.
2. Advancement of the use of remote sensing in bioevent detection (Remotely Sensed Epidemic Surveillance).
3. Integration of multiple data sources for comprehensive biothreat assessments.
4. Demonstration of added value of using Indications and Warnings (i.e., “graded alerting”) for rapid biological event detection and threat assessment.

8. Obstacles and Lessons Learned

We encountered significant obstacles in obtaining media sources from Venezuela in 1995. As a result, the team had to rely on traveling to Venezuela to manually extract media articles, a tedious and time-consuming endeavor. This also posed problems as the research methods and thinking evolved, as the investigator who extracted the articles had focused primarily on societal I&Ws as opposed to environmental I&Ws. This forced the use of national papers held in archive at the Library of Congress and limited the environmental analysis to national reporting. Additionally, we faced significant challenges in translating and cataloguing retrieved articles.

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10. Attachments

Attachment A: VEE 1995 I&W Matrix